

# OPTIMIZING GRAPHICS FOR THE WEB

*Preparing to Transfer Graphics Across the Web*

**In this chapter, you will:**

- ◆ Understand the effect of color on file size
- ◆ Change color depth
- ◆ Select a file format
- ◆ Save files as Web graphics
- ◆ Optimize images with Photoshop and ImageReady

**W**eb graphics are different from other computer graphics because they must be transferred across the Internet. Large files take a long time to transfer, forcing users to wait while the images download on their computer. Your goal is to make graphics files as small as possible while still illustrating the content you intend. Most graphics files contain unnecessary data that can be discarded without affecting the appearance of the image. Eliminating unnecessary data is called optimizing, and results in small image files that users can download more quickly from the Web to their computers.

You can optimize an image file either by reducing the number of colors used by the image, or by compressing the data stored in the image file. The color-reduction method is better for images with solid color, and the compression method is better for images with gradations of color.

You should optimize every Web graphic you create. Learning how to optimize computer graphics for the Web is the focus of this chapter.

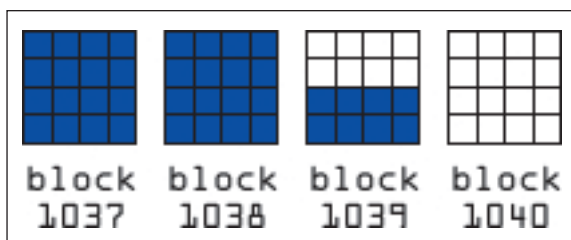
## UNDERSTANDING THE EFFECT OF COLOR ON FILE SIZE

Like all files that make up Web pages, graphics files should be as small as possible so they download quickly. Images with more colors tend to have larger file sizes than images with very few colors. The trick is to reduce the number of colors in an image without reducing the quality of the image.

### Understanding File Size

The smallest unit for measuring the size of an image file is the bit. A bit is a BInary digiT and is basically a tiny space in a computer's memory that acts like a switch that can be turned on (set to 1) or off (set to 0). A byte is a more common unit, and is equal to 8 bits. The next largest unit is the kilobyte, which is equal to 1,024 bytes. A kilobit is 1,024 bits, or one-eighth the size of a kilobyte. Kilobits are usually used when measuring network transfer speeds. Modems are characterized by their transfer rate, measured in kilobits per second (Kbps).

File size is measured in kilobytes. The term kilobyte is often shortened to KB or just K, as in "Keep the animated ad banner under 12 K." Operating systems and other software usually display file size in terms of block sizes instead of kilobytes. Think of an ice cube tray as a block of memory, with each of the 16 wells being a kilobyte. If you have a file of 40 kilobytes, you need three trays, but do not fill all of the wells. All the same, your operating system detects that the file uses three trays and lists the size as 48 kilobytes (three full blocks of 16 kilobytes each) instead of the true number, 40. This rounding up is misleading, and indicates the file is bigger than it really is. In Figure 2-1, the blue area shows 40 kilobytes being used, although the computer counts three blocks, or 48 kilobytes, in use.



**Figure 2-1** File using 40 kilobytes, but three blocks



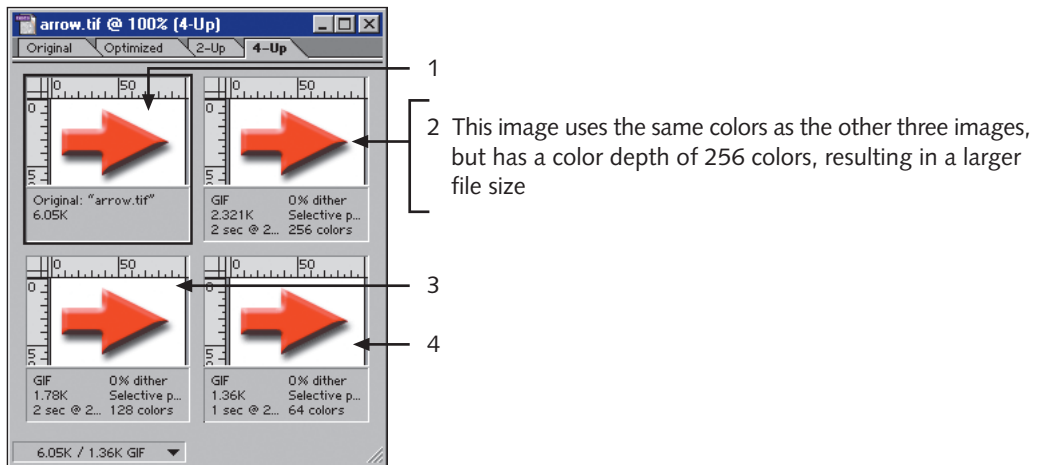
To see the true size of a file on a Macintosh computer, select a file and choose Get Info from the File menu. On a Windows computer, right-click the file in Windows Explorer or My Computer, and then click Properties to see the file size.

The number of bits in an image file is set by the three dimensions of height, width, and color depth. If two images show rectangles, but one rectangle is wider and taller than the other, the larger image has a larger file size. The size of an image file is also based on color, as explained in the following section.

## Understanding Color Depth

As defined in the previous chapter, a bitmap image is a grid of pixels. You can easily see that an image has a certain width and height. What is not so obvious is that an image has a specific depth as well. The **color depth** of an image is the number of available colors for each pixel. Color depth is sometimes called bit depth or pixel depth. Just as increasing the height or width of an image increases the file size, increasing the color depth of an image also increases the file size.

The color depth does not indicate how many colors are actually used in an image. It only tells you how many colors are available for the image. You cannot calculate the color depth of an image by looking at it. The images in Figure 2-2 all use the same number of colors, but have different color depths. The images with greater color depths have more memory allocated to them, increasing their file size. Image 1 is the original, unoptimized image and uses about 6 KB. Image 2 has a color depth of 256 colors and uses about 2.3 KB. Image 3 has a color depth of 128 colors and uses about 1.8 KB, while Image 4 has a color depth of 64 colors and uses about 1.4 KB. Yet these images are identical; — images 1, 2, and 3 do not need the extra depth to show all their colors. The extra memory is wasted and makes the image files unnecessarily large.



**Figure 2-2** The same image using different color depths

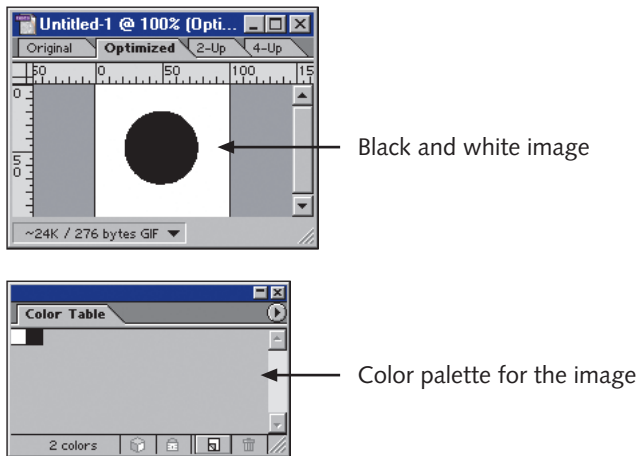
The number of colors actually used in an image is called the **color palette**, also called the **color table**. (This is unrelated to the Color palette in Photoshop and ImageReady.) The color palette of an image cannot be larger than the color depth, but can sometimes be smaller. For example, in Figure 2-2, image 2 has a color depth of 256 colors, but a palette of 64 colors. An image with a color depth of 256 colors can have a palette of any size up to 256 colors.

As discussed in the “Understanding File Size” section, each pixel is associated with at least one bit of computer memory. For a black and white image, each pixel has exactly one bit associated with it. If the bit is set to 1, the pixel is white; if the bit is 0, the pixel is black. This is called 1-bit color depth and yields a palette of two colors. The word *bitmap* is often used to describe these 1-bit, black and white images.



The term *bitmap* can mean two things. As noted in the “Introduction to Web Graphics” chapter, a *bitmap* refers to a computer graphic that is not vector based. All rasterized images are *bitmaps*. *Bitmap* also means an image with 1-bit color depth.

Figure 2-3 shows the color table of an image with a 1-bit color depth that yields two colors: black and white.



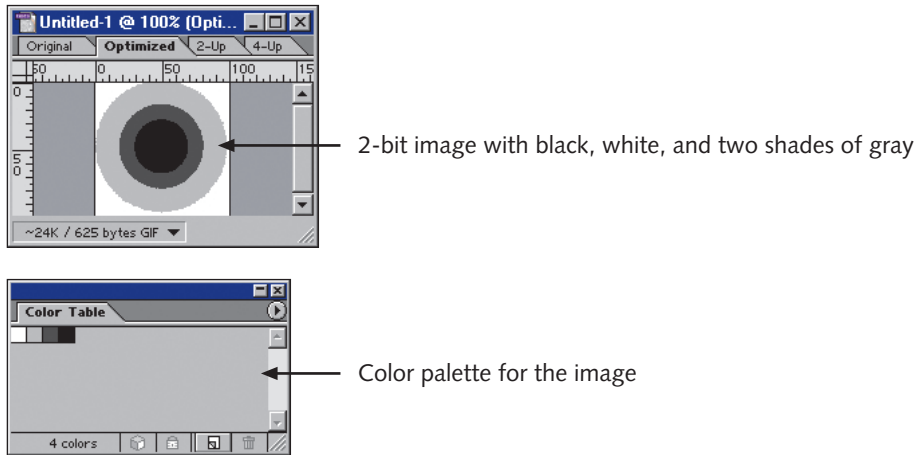
**Figure 2-3** The color palette for a 1-bit image

An image with 2-bit color has two bits associated with each pixel, giving four colors in the palette ( $2 \times 2 = 2^2 = 4$ ). Table 2-1 shows the possible combinations of bits and colors in a 2-bit color image.

**Table 2-1** Two-bit color depth provides a palette of four colors

Bit 1	Bit 2	Color
0	0	Black
1	0	Color a
0	1	Color b
1	1	White

Colors a and b could be any color: two shades of gray, red and blue, green and dark green, and so on. Figure 2-4 shows the color table of an image with 2-bit color depth that yields four colors: black, white, and two shades of gray.



**Figure 2-4** A possible color palette for a 2-bit image

Adding another bit doubles the possible colors again, so that 3-bit color yields eight colors in the palette ( $2 \times 2 \times 2 = 2^3 = 8$ ). Table 2-2 shows the possible combinations of bits and colors in a 3-bit color image.

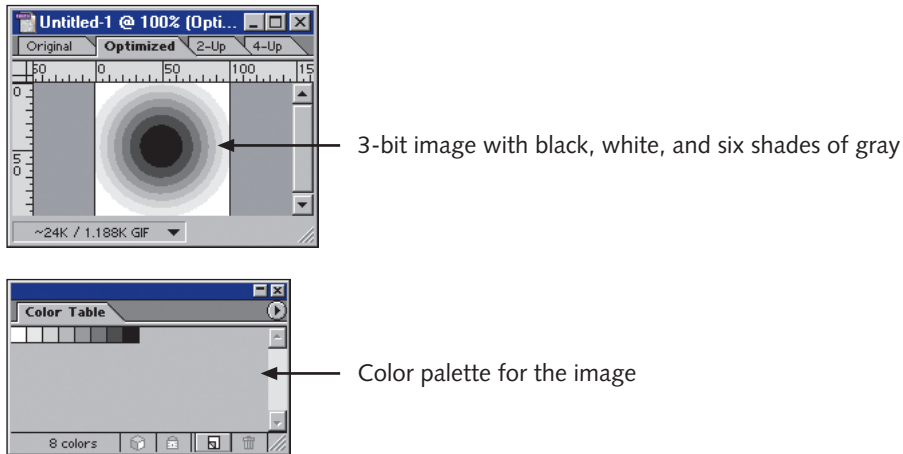
**Table 2-2** Three-bit color depth provides a palette of eight colors

Bit 1	Bit 2	Bit 3	Color
0	0	0	Black
0	0	1	Color a
0	1	0	Color b
0	1	1	Color c
1	0	0	Color d
1	0	1	Color e
1	1	0	Color f
1	1	1	White

Figure 2-5 shows the color table of an image with 3-bit color depth that yields eight colors: black, white, and six other colors.

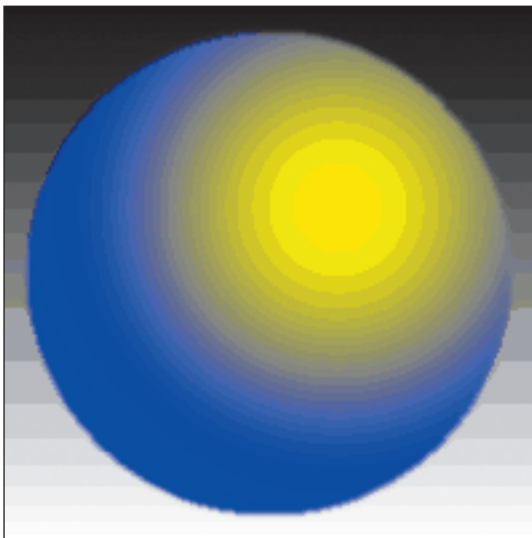
An image with 4-bit color adds another bit for each pixel, and doubles the number of colors again to create a maximum of 16 colors in the palette ( $2 \times 2 \times 2 \times 2 = 2^4 = 16$ ). With each additional bit, the color depth doubles, and the size of the file roughly doubles as well. Changing the color depth does not necessarily affect the color palette. If an image uses

10 colors in its table, and you change the color depth from 4-bit (16) to 5-bit (32), the table does not change. It still contains 10 colors with several unused colors available. If the depth changes from 4-bit (16) to 3-bit (8), however, the color palette loses two colors.



**Figure 2-5** A possible color palette for a 3-bit image

Color depth can be any power of two, up to  $2^8$ , or 256 colors. Although 256 seems like a lot of colors, some images, such as those with smooth gradations of color require far more than 256 colors to look realistic. Figure 2-6 shows an image with 64 colors, clearly not enough to replicate the transition from one color to another.



**Figure 2-6** An image with inadequate color depth



You can use 16-bit color in Photoshop, which produces  $2^{16}$ , or 65,536 colors. However, 16-bit images do not display on many browsers because they use 16 bits per channel.

If 8-bit color depth is not enough, you can increase the depth to 24 bits. A color depth of 24 bits divides the color information of the image into three **color channels**, one for red, one for green, and one for blue. Each channel is an 8-bit color table containing only shades of one primary color. This creates a much larger color table, with 16,777,216 different colors. This number, usually called millions of colors or 16 million colors, is the result of multiplying the color depths for each color channel,  $2^8 \times 2^8 \times 2^8 = 256 \times 256 \times 256 = 2^{24} = 16,777,216$ .

When you decide which color depth to use, keep in mind that increasing the depth sometimes increases the quality of the image, and always increases the file size. Keep the color depth as small as possible without sacrificing image quality. For example, you can convert some 8-bit images to 7-bit color and roughly halve the file size without hurting the detail in the image.

Table 2-3 shows all the color depths you can use in computer graphics and their corresponding color palette. It also lists appropriate uses for some palettes.

**Table 2-3** Table of possible color depths

Color Depth	Maximum Color Palette	When Used
1-bit	2 colors	Line art, black and white
2-bit	4 colors	
3-bit	8 colors	Good for most scanned black and white drawings and figures
4-bit	16 colors	
5-bit	32 colors	Minimum depth for most color images
6-bit	64 colors	
7-bit	128 colors	
8-bit	256 colors	Maximum color depth for GIF and PNG-8 images One full-color channel
24-bit	16,777,216 colors	Only depth available for JPEG and PNG-24 images RGB Color Three full-color channels
32-bit	16,777,216 colors, plus a fourth 8-bit transparency channel	RGB plus alpha

## Using Color Modes in Photoshop and ImageReady

In Photoshop and ImageReady, color depth is referred to as **mode**. To choose color depth, click Image on the menu bar, and then point to Mode. You will see a list of color modes, including Bitmap, Indexed, and RGB; most of the modes are meant for print projects and are not appropriate for Web graphics. The two color modes you use for Web graphics are RGB color and indexed color. Indexed color has a depth of between 1-bit and 8-bit. RGB color is 24-bit color.

### Using RGB Color

In RGB mode, the color depth is 24 bits; each of the three color channels has a value between 0 and 255. Recall that combining the three channels produces over 16 million possible colors.

You should use RGB color mode to edit images because many filters work only with this mode. RGB color creates large files, however, so save images with this mode only when they have rich color gradients, or when they are photographs with many colors.

When you create and save Web graphics, always start with 24-bit RGB color as you edit the image. If necessary, reduce the color depth later, when you are ready to save the image. If you need to edit an existing image, increase the color depth to RGB before you edit. All painting tools, filters, and other editing tools produce better results when you use them in RGB mode.

To increase the color depth to RGB color, select an image and then follow the steps below.

To increase color depth to RGB color:

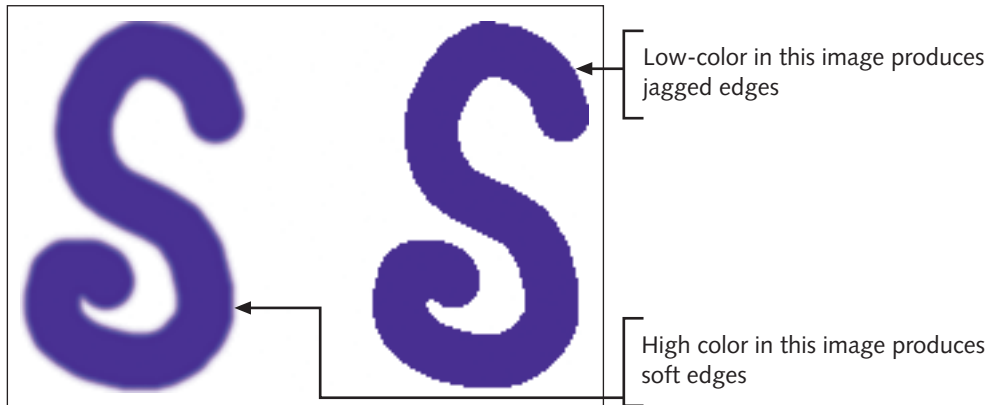
1. Click **Image** on the menu bar.
2. Point to **Mode**.
3. Click **RGB Color**.

You will not see a change in the image, because the actual colors used in the image have not changed. What has changed is the number of available colors. This improves the results when you edit the image.

### Using RGB Color to Control Jagged Edges

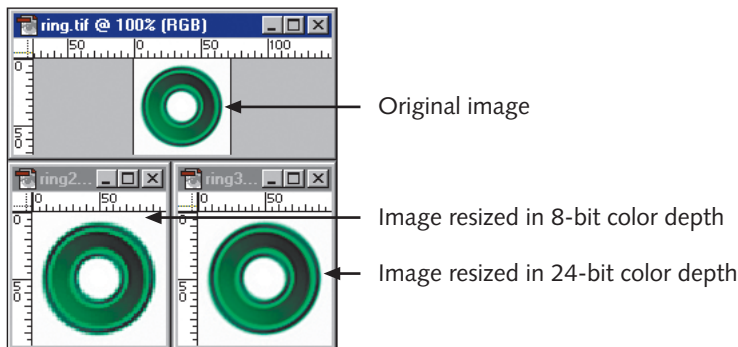
Hundreds or thousands of colors in a palette might seem like more than enough, especially for a simple black-and-white image. But, when you use all the colors, they fill in the feathered areas between the image's foreground and background. You can see the difference when you reduce the color palette of an image containing a diagonal or curved line. What was a straight, soft line becomes a ragged staircase. This rough line is described as being **jaggy**, and has an abrupt transition from foreground to background. As you can see in Figure 2-7, reducing colors too much results in jaggy edges.





**Figure 2-7** The same image in a jagged low-color version and a high-color version

When you resize an image or use a paint tool, Photoshop adds pixels to fill in the gaps created when the original pixels are spread out. Photoshop fills in the missing spaces by **resampling** or interpolating, that is, calculating the proper colors to use between the original pixels. Figure 2-8 shows an image resized in 8-bit and 24-bit color depth.



**Figure 2-8** Resizing in different modes

As you learned in the Introduction to Web Graphics chapter, to resize an image in Photoshop, you click Image on the menu bar, and then click Image Size to open the Image Size dialog box, where you can specify the width and height of the image. When resizing an image, Photoshop resamples the image to interpolate the missing pixels. You can resample pixels in one of three ways: **Nearest Neighbor**, **Bilinear**, or **Bicubic**.

The Nearest Neighbor method produces jagged edges, while the Bicubic method produces smooth edges by interpolating pixels. The Bilinear method produces edges that are somewhat less smooth than the Bicubic method. The first two methods, Nearest Neighbor and Bilinear, are faster when you are working on very large images, but Bicubic interpolation, the default method, produces the smoothest results, and is your best choice for Web graphics.

The effects of interpolation are visible only when an image contains curved lines or gradients. You should save these images in 24-bit RGB color. You can safely use indexed color to save images that contain only vertical or horizontal lines and have no gradations of color.

## Using Indexed Color

If 24-bit color is more than an image needs, or produces a file that is too large, you should reduce the color to Indexed Color mode. While RGB color must have exactly 24 bits of color in the palette, indexed color images can have any number of colors, up to 8-bit, or 256 colors.

## Using the Color Look-up Table with Indexed Colors

Recall that an 8-bit color palette devoted to a specific primary color is called a color channel. The color palette for an indexed color image is called a **clut**, or **color look-up table**. An indexed color image can have a color depth of three bits, which means the color palette holds up to eight different colors, one in each cell of the palette. But the image might have only some of these colors. If it uses five colors, for example, it leaves the other three cells in the palette empty. When software, such as Photoshop or a Web browser, opens the image, it also opens the associated color table and looks up the proper color for each pixel.

The clut can list up to 256 colors, and each color has a unique ID. To see the clut for an indexed color image in Photoshop, you click Image on the menu bar, point to Mode, and then click Color Table. In ImageReady, the clut has its own palette. Open the image, and then to show the Color Table palette you click Window on the menu bar, and then click Show Color Table. The clut can have a maximum of 8 bits of color (256 colors), but often uses fewer to reduce file size. The Color Table palette in ImageReady is shown in Figure 2-9.

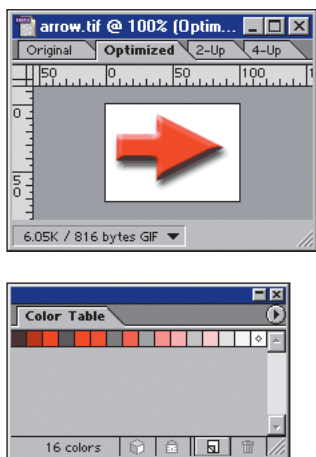
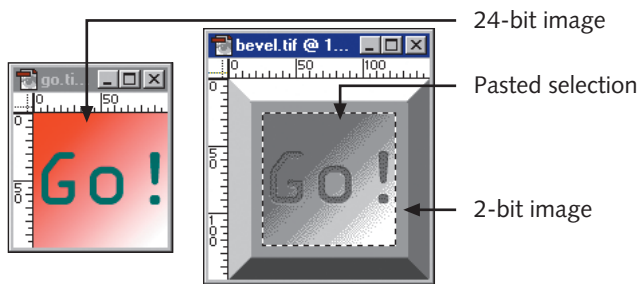


Figure 2-9 The Color Table palette

Some cluts are preset and always have the same colors in the same order. Among these preset color tables are the system color tables for Macintosh and Windows and the **Web-safe** color table, which has only 216 colors. Different browsers and operating systems use different default color palettes. The 216-color Web-safe color table provides a standard for Web pages, which is viewed on different types of browsers and platforms. These 216 colors are the only ones guaranteed to look the same on every viewing environment.

With indexed-color images, different images can have different cluts. When you paste an image selection into an image with indexed color, the colors of the pasted areas are different in the new image. For example, in Figure 2-10, the colors in the image named *go.tif* contain shades of red and green, but the image named *bevel.tif* uses a color table with only six shades of gray. When the full-color image is copied and pasted into the image with reduced colors, the pasted selection automatically matches the existing palette, resulting in undesired colors. To solve this problem, you increase the colors in the destination image. This is a potential difficulty in Photoshop, but not in ImageReady. ImageReady automatically converts every image to RGB mode.



**Figure 2-10** Pasting into an indexed-color image with a reduced clut

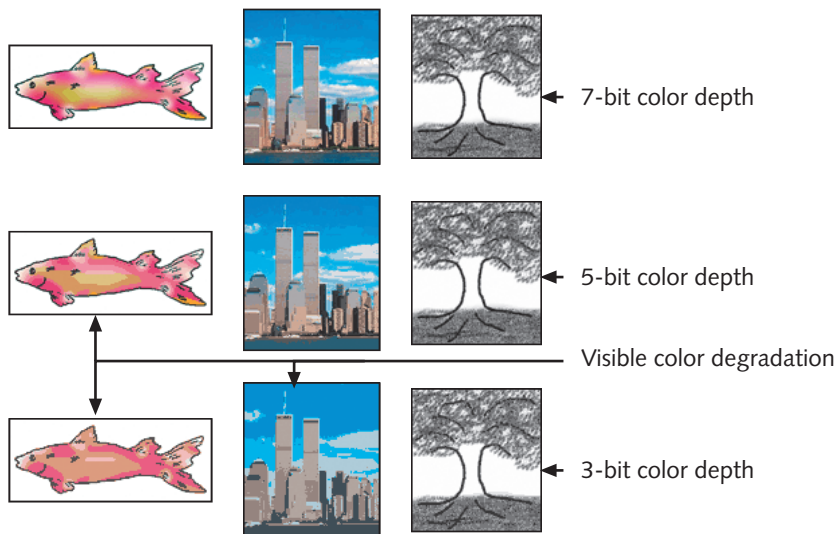
If you edit images or copy and paste between images in 24-bit color, all possible colors are available, and mismatching of colors in the table does not occur. This is why you should use 24-bit color while editing and manipulating files, even if you plan to save the image in a lower color depth.

## CHANGING COLOR DEPTH

The process of reducing file size by reducing the number of colors is called optimization through color-reduction. If you reduce color depth from 8-bit (256 colors) to 7-bit (128 colors), you halve the number of available colors in the color palette and reduce the file size by almost half as well. An image with 5-bit color depth has roughly one-quarter the file size of an image with 8-bit color depth.

You can reduce many color images to 5-bit color before they show any negative effects. You also can reduce grayscale images (those with up to 256 shades of gray) to 3-bit color without losing any vital image data. Figure 2-11 shows a color drawing, a photograph,

and a black-and-white drawing with different color depths. The color drawing uses the most colors in its smooth gradations from one tone to the next. The quality deteriorates at depths below 7-bit. The photograph also uses many colors, but no tonal variation, and the quality deteriorates with a depth below 5-bit. The grayscale drawing tolerates color depth as low as 3-bit.



**Figure 2-11** Different images require different color depths

Large high-quality images, such as photographs or 3-D images, often lose image data even at 8-bit color depth. These images should remain at 24-bit color.

To reduce the color depth to 8-bit color in Photoshop, select the image and then follow the steps below.

To reduce color depth to 8-bit:

1. Click **Image** on the menu bar.
2. Point to **Mode**.
3. Click **Indexed Color**. This option lets you set any number of colors from 1-bit (2 colors) to 8-bit ( $2^8 = 256$  colors). You see the Indexed Color dialog box, illustrated in Figure 2-12.
4. Set the palette to **Local (Perceptual)**.
5. In the Colors text box, set the number of colors, from **2** to **256**, if necessary, and then click **OK**.

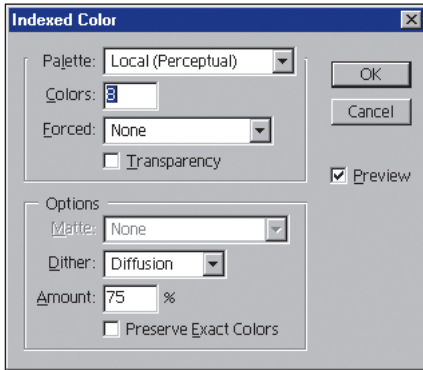


Figure 2-12 Adjusting the color depth

## Choosing a Palette

When you reduce the color depth of an image, you reduce the number of available colors in the color table. If the image uses more colors than are available in the new color depth, some colors are eliminated.

When you reduce colors from the roughly 16 million available in 24-bit images to 256, for example, Photoshop finds the 256 most commonly occurring colors and uses those in the palette. To do this, Photoshop uses a **color reduction method**, which is a formula for counting the most common colors.

To select a color reduction method, open the Indexed Color dialog box shown in Figure 2-12, and then click the Palette list arrow. You see the following list of options:

- *Exact*: Creates a clut based on the colors currently used in the image. If the image has 256 or more colors, the clut contains the 256 most commonly used colors. You should use Exact only if the image uses very few colors and does not need to be reduced.
- *System* (Windows or Mac OS): Uses the Windows or Macintosh system 8-bit palette. This option is seldom used for Web graphics.
- *Web*: Uses the Web-safe palette of 216 colors. This palette reduces the amount of dithering (explained later in this chapter) that occurs in certain monitors.
- *Uniform*: Creates a palette of uniformly sampled colors. Most images do not have uniformly distributed colors, so this reduction method usually produces poor results.
- *Perceptual*: Creates a customized palette, giving weight to colors to which the human eye is more sensitive.
- *Selective*: Is similar to the Perceptual color reduction method, but also gives weight to colors in the Web palette. This method usually produces the best color reduction results.

- *Adaptive*: Creates a table with colors from specific areas of the color spectrum, based on which colors exist in the image.
- *Custom*: Lets you create your own customized palette, or load a previously saved one.
- *Previous*: Uses the color table from the last image you converted. This is useful for some print projects, but is not so useful for Web graphics.

The three methods you use most often when creating Web graphics are Adaptive, Selective, and Perceptual. These methods produce similar results.

When you select the Uniform, Adaptive, Selective, or Perceptual color reduction method, you can specify how many colors to use in the final color table. Because the bit depth of indexed color images has a maximum of 8-bits, the maximum number of colors you can use is 256. Using fewer colors results in an image with smaller file size.

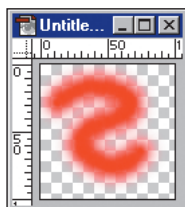
## Setting Other Color Reduction Options

In creating the color table, you can force certain colors to appear, regardless of how often they appear in the image. Some software requires all images to have black and white in the color table.

To include black and white in the color table:

1. Select the **image**, and then to open the Indexed Color dialog box, click **Image** on the menu bar, point to **Mode**, and then click **Indexed Color**.
2. Click the **Forced** list arrow, and then click **Black and White** so that the image can be edited later in other image software. (You do not need to use the other options in the Forced list for Web graphics.)

When you create a new image, you can choose whether the background is white, is based on the background color in the toolbox, or is transparent. When you add colors to the image, the transparent areas are covered, as shown in Figure 2-13. You can preserve transparency so that the final image allows background colors to show through when displayed in a Web browser. (Transparency is discussed in detail later in this chapter.)

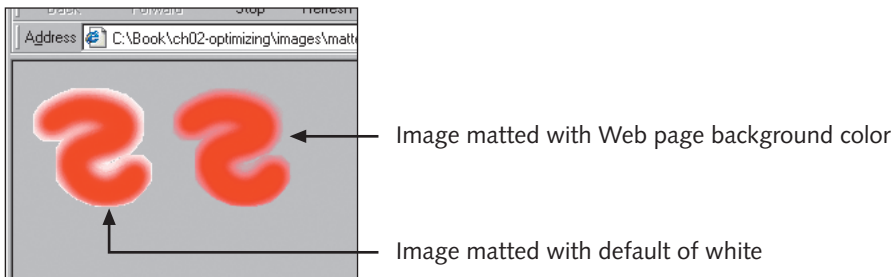


**Figure 2-13** An image with a transparent background

To set the background color of an image:

1. Select the **image**, and then to open the Indexed Color dialog box, click **Image** on the menu bar, point to **Mode**, and then click **Indexed Color**.
2. To make the parts of the image with no color values transparent, click the **Transparency** box to check it, if necessary.
3. To fill any existing transparent areas with the matte color, click the **Transparency** box to clear it. Then click the **Matte** list arrow and select a color, which is white by default. You can specify a matte color even when you select the Transparency box. The matte color then affects how feathered edges blend with the background color. If your images will appear in a Web page that has a colored background, make sure to set the matte color to the background color of the page.

Figure 2-14 shows an image with transparent areas and a white matte against a colored background. You can see how the edges of the image do not match the background color. The figure also shows an image saved with the proper matte color.

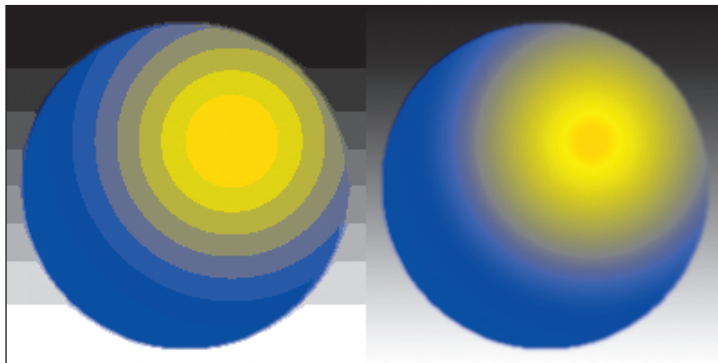


**Figure 2-14** Incorrect and correct matte colors

## Using Dither

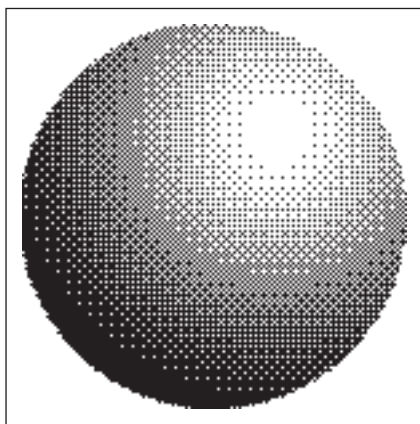
Unless you use the Exact color reduction method (see the “Choosing a Palette” section earlier in this chapter), the color table probably will not exactly match the colors used in the image. As you experiment with different color depths, you will notice that areas of gradient color develop stripes of color where there should be a smooth transition.

When you reduce the color palette from 24-bit to 8-bit, even for images with simple gradations of color, **banding** often results. **Banded color** has thick stripes of color, instead of imperceptible color changes. Even though the 8-bit color palette has 256 colors, it isn't enough to prevent banding. Figure 2-15 shows that banding is most noticeable in areas of gradient color.



**Figure 2-15** A banded low-color version and a high-color version of the same image

To prevent banding, try leaving the color depth at 24-bit. You also can simulate colors not in the color table by **dithering** existing colors. Dithering is a procedure used in many types of graphics in print and on the Web to simulate colors when the actual colors are not available. Instead of finding intermediate shades of color the way interpolating does, dithering creates patterns of color to simulate other shades. In print, for example, often the only available colors are the white of the page and black ink. To simulate shades of gray in images, the black ink is dithered, as shown in Figure 2-16, creating tiny dots of black in varying concentrations. These dots give the illusion of being shades of gray when viewed from a distance.



**Figure 2-16** Dithering to simulate intermediate tones

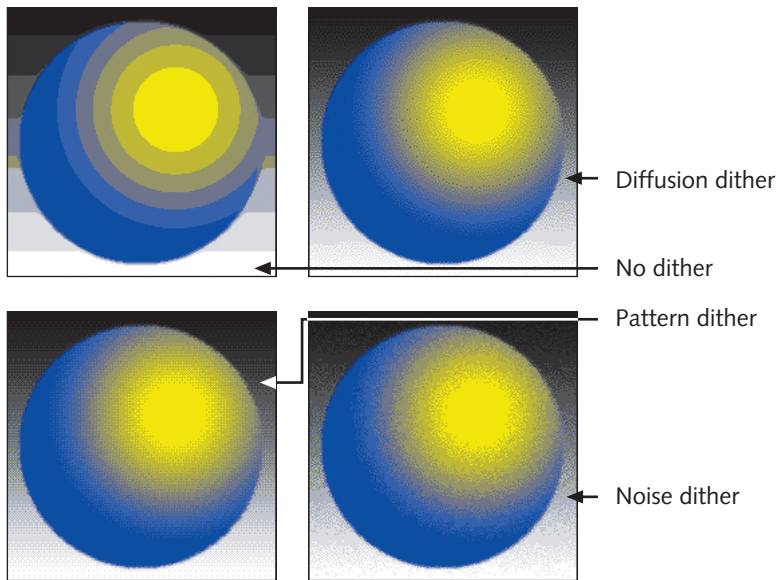
To dither gradient colors:

1. Select an **image** with reduced colors, and then to open the Indexed Color dialog box, click **Image** on the menu bar, point to **Mode**, and then click **Indexed Color**.



2. To prevent banding of gradient colors, click the **Dithering** list arrow and choose one of the dithering options described below:
  - *None*: Uses no dithering and causes banding of graduated colors.
  - *Pattern*: Uses a pattern of squares to dither the colors in the image. The pattern is unsightly and noticeable. You could use this for some print projects, but not for Web graphics.
  - *Diffusion*: Produces a pattern that is not as obvious as the Pattern dither.
  - *Noise*: Produces a random pattern. For Web graphics, use this or the Diffusion dither.

Figure 2-17 shows an image reduced to 4-bit color using the four different types of dither. The diffusion dither pattern usually produces the smoothest gradations.

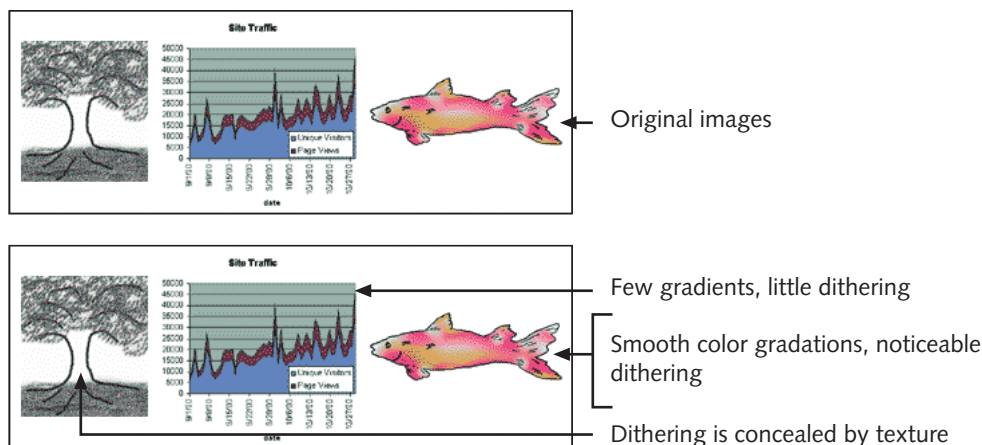


**Figure 2-17** The four dither options

When you choose the diffusion dither pattern, you also can select the amount of dither to use, as a percent from 0 to 100. A higher percentage dithers more colors, but increases the size of the file.

Normally, dithering affects all colors in the image, whether they are in the final color table or not. To dither only the colors that are not in the table, select the image, open the Indexed Color dialog box, and then click the Select Preserve Exact Colors box to check it. This prevents thin lines, such as text, from being dithered.

Dithering is appropriate for images with a lot of visual texture, such as photographs. The dither patterns are more noticeable in images without texture. Figure 2-18 shows images with different amounts of visual texture and the effect of dithering. The center image has no gradients, so little dithering occurs. The images on the left and right both have dithering, but the effect is concealed by the texture in the image on the left. The image on the right has noticeable dithering because of the smooth color gradations in the original image.



**Figure 2-18** Dithered images with different amounts of gradients and texture

## Controlling Color Reduction

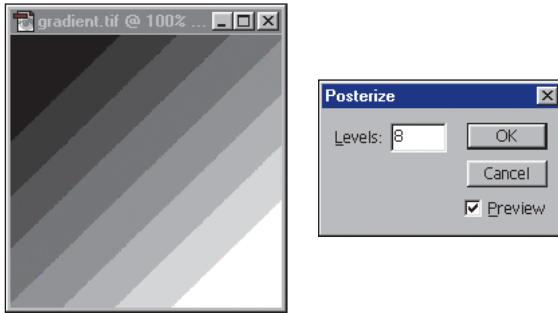
If reducing colors using the Indexed Color dialog box does not give you the control or results you want, you can use other Photoshop and ImageReady options. You can reduce colors by posterizing them or setting a threshold, and then convert the image to indexed color.

### Using the Posterize Command

A quick way to change the number of colors in an image is to **posterize** the image. In Photoshop, this means reducing the colors used in an image without changing the colors in the color palette.

To posterize an image in Photoshop:

1. Open an **image** and then click **Image** on the menu bar.
2. Point to **Adjust**.
3. Click **Posterize**. You see the Posterize dialog box and your image, as illustrated in Figure 2-19.
4. In the Levels text box, enter the number of colors you want to use in the palette, and then click **OK**.

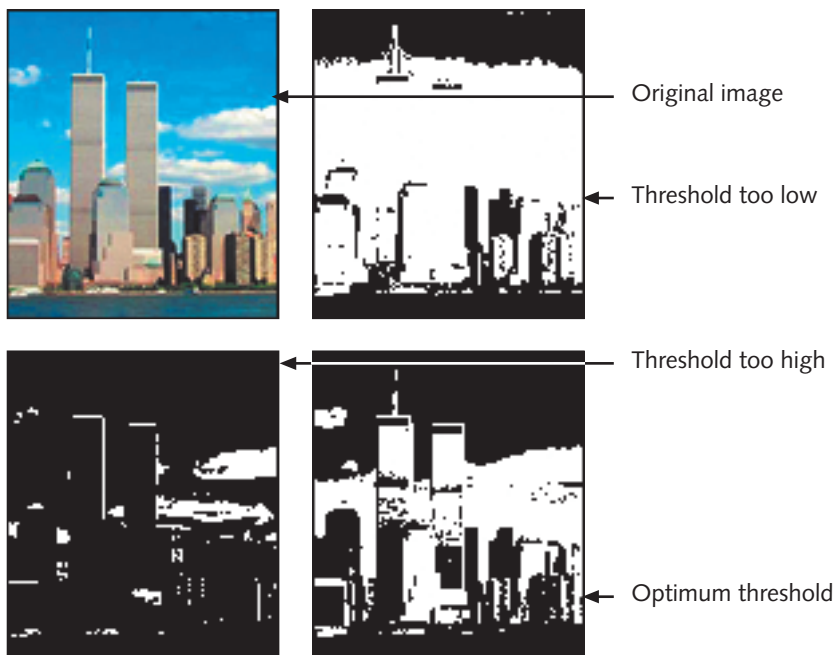


**Figure 2-19** Posterizing an image

The Posterize dialog box lets you define the number of colors used in the palette. Although this reduces the palette, it does not affect the color depth. After you posterize an image, make sure to convert the image mode, for example, to Indexed or Grayscale. You can posterize an 8-bit image with 256 colors in its palette, and reduce it to use only two colors. The palette then contains the two colors in the image, plus 254 unused colors.

### Using the Threshold Command

You sometimes will need to convert images to 1-bit color using just black and white. For example, if you have letterhead or a form for outgoing faxes, you might need to use a black-and-white version of your Web site logo. If you do not carefully reduce the color, the final image can appear too dark or too light, as shown in Figure 2-20.



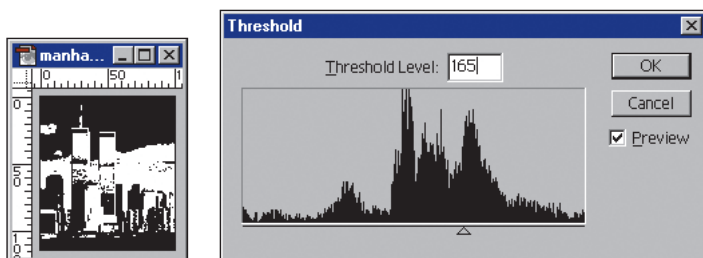
**Figure 2-20** A 1-bit image reduced from a higher bit-depth

When you reduce colors to 1-bit color depth using the Indexed Color dialog box, Photoshop uses a **threshold** of 50%. This converts every pixel that is lighter than middle-gray to white, and every pixel that is darker than middle-gray to black.

A 50% threshold works well for most bitmap color images, but you might find that it produces images that are too dark or light, such as those produced by photocopiers or fax machines. In Photoshop, you can control the threshold using the Threshold command.

To use the Threshold command in Photoshop:

1. Click **Image** on the menu bar.
2. Point to **Adjust**.
3. Click **Threshold**. The Threshold dialog box appears, as shown in Figure 2-21.



**Figure 2-21** The Threshold dialog box

The Threshold dialog box shows a graph of all the color information in the image, with pure black at the left, pure white at the right, and middle-gray controlled by the slider bar in the middle. Each vertical line in the graph represents a shade of gray. Dark images have histograms with more lines on the left, and light images have more lines on the right.

4. Make sure the **Preview** box is checked.
5. To set the threshold at which grayscale pixels are converted to black or white ones, adjust the middle-gray slider. Drag the **slider** to the left to produce a lighter image, or drag it to the right to produce a darker one. Watch the image as it changes, and stop when you find the best setting.

Instead of dragging the slider, you also can enter a value in the Threshold Level text box to change the threshold.

6. Click **OK**.
7. Convert the mode to **Indexed Color** and use any of the conversion methods. Because the image already contains only black and white, the image should not change.

Different types of images require different color depths. Once you determine the needs of an image, you can set the depth, and select an appropriate file format.

## WORKING WITH FILE FORMATS

Every computer file uses a particular kind of file format. Microsoft Word documents are saved in a .doc format, and Web pages are saved as .html files. Similarly, you can save graphics as .pict, .tif, or any of the many of existing graphics formats. Each format has different capabilities regarding color depth, transparency, animation, and other qualities. Most formats can be easily converted from one to the other.

Although you can save an image in Photoshop in a variety of formats, only a few formats can be used for images that will appear in a Web page. Web browsers on their own can display only three formats: GIF (.gif), JPG (.jpg or .jpeg), and PNG (.png). GIF and JPEG are standard formats and can be viewed in any browser. PNG is a newer format and is supported only by newer browsers. Although most users can see PNG images with their browsers, a small percentage cannot. Avoid using the PNG format unless you are confident that all users who visit your Web pages have the latest browsers.

Browsers can display formats other than GIF, JPEG, and PNG, but require additional special programs to do so. Some of these programs are helper applications, which open the images in a new window. Yet another type of program is called a **plug-in**, and is incorporated into the user's browser.

### Using Plug-ins

Recall from the Introduction to Web Graphics chapter, that Web browsers cannot rasterize vector images, so they need additional software to convert vector images to bitmap images. The software that rasterizes vector images within a Web browser is one type of plug-in; you use a different plug-in for each vector format. You can even find plug-ins for nonWeb bitmap formats such as TIFF. One common plug-in is used for Flash, and allows browsers to display vector animations. You also can use a plug-in to view text documents, such as Microsoft Excel or Adobe Acrobat files, in a browser. The drawback to using plug-ins is that only some versions of browsers include certain plug-ins. This means you can never be sure whether your audience has the proper plug-in. If they don't, they won't see your image or animation.

When selecting a graphic file format, choose GIF or JPEG. They are the only format that do not require users to have a particular plug-in.

### Using GIF Images

The **Graphics Interchange Format (GIF)** supports 8-bit color, but not 24-bit color. It is an appropriate format for images that can tolerate optimization through color-reduction. GIF supports transparency and even animation. Because of this, GIF is the most useful Web graphics format, and the one you probably will use most often for Web graphics.

GIF's strengths make it a good file format for small, fast-loading images, animations, and images that have irregular shapes. But it is not a good format to use for high-color images such as photographs.

You might occasionally see GIF referred to as gif87 or gif89. The version of the GIF format released in 1987 (gif87) does not support animation, but the version released in 1989 (gif89) does. Current image-editing programs save GIF files with the newer gif89 version.



Before you save a GIF image, convert it to Indexed Color mode. If you are trying to save an image as GIF in Photoshop, but notice that GIF is not listed as an option in the Save as type list, change the image to Indexed Color, and then save the file.

## CompuServe and GIF

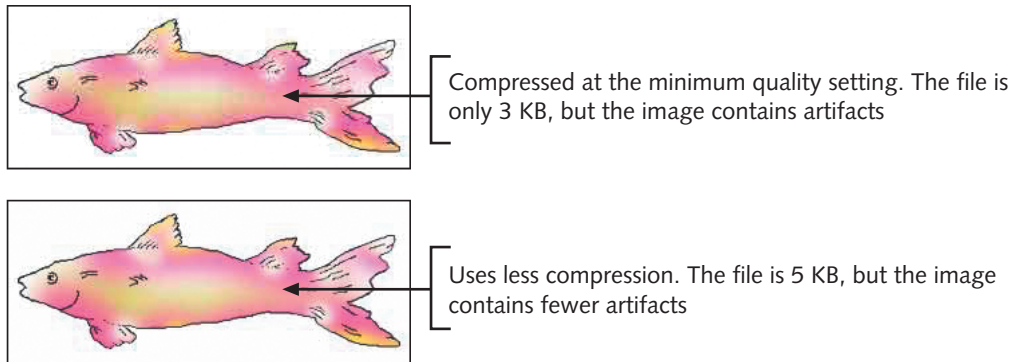
When you save an image in the GIF format in Photoshop, the format in the Save as type text box is CompuServe GIF. This is because CompuServe owns the patent to the compression algorithm (known as LZW compression) used in the GIF format (and in the TIFF format). CompuServe charges licensing fees to companies such as Adobe so that they can use the LZW formula to open and save files in the GIF format. A few years ago CompuServe stated they will charge up to \$5,000 for any site that uses GIF images created with software made by companies that have not paid the licensing fee. You, therefore, should be concerned about the source of your GIF images. If you use products like Photoshop, where Adobe pays the licensing fee to CompuServe, you won't be charged an extra fee. Exercise caution in using a freeware or shareware image editor. If the developers of those tools haven't paid the licensing fee, you are technically breaking the law by creating GIF files with them. The patent on LZW compression expires in 2002.

## Using JPEG Images

The **Joint Photographic Experts Group (JPEG)** format supports 24-bit color, but not 8-bit color. The JPEG format is supported by all browsers and is an appropriate format for photographs and other high-color images. JPEG does not use color-reduction to optimize image files. It uses another type of optimization called **compression**. Compression is a mathematical manipulation of the file itself, and selectively eliminates areas of detail in the image to reduce the size of the file. This sort of compression results in lost image data and is called **lossy compression**. GIF images also use compression to reduce file size, but this compression does not discard image data and is called **lossless compression**.

You can adjust the amount of compression used in a JPEG image. A higher compression creates a smaller file, but also produces blocks of banded color called **artifacts**. These artifacts are more noticeable in images with areas of solid color, and appear near areas of high contrast, such as around text or where dark lines occur against a light background. For this reason, avoid using JPEG compression for images containing text.

Figure 2-22 shows an image with different compression settings. The image on the top is compressed at the minimum quality setting. The file is only 3 KB, but the image contains artifacts. The image on the bottom uses less compression. The file size is nearly 5 KB, but the image contains fewer artifacts.



**Figure 2-22** An image with different degrees of compression

Each time you save a JPEG image with compression, new artifacts are generated. When you edit a JPEG file, use an original version that has not been compressed, if possible.

The JPEG format does not support transparency or animation. If you save an image that contains transparency as a JPEG, all transparent areas are filled in with the matte color.

## Using PNG Images

A new, free format has emerged in the past few years, and is called **PNG** (pronounced “ping”). Although the acronym officially stands for **Portable Network Graphic**, the unofficial name is PNG Not GIF, as it is intended to replace the GIF format.

PNG has some advantages over GIF images. One is that PNG images can be 24-bit or 8-bit color, so PNGs can have small color palettes like GIFs or large color palettes like JPEGs. Another advantage is that PNGs support 8-bit transparency, while GIF supports only 1-bit transparency. This means the edge of a PNG fades smoothly into the background of a Web page, while GIFs tend to have ragged edges.

Another advantage of PNG is that the format is completely open-source, meaning anyone can develop software to work with PNG files without paying a license fee. Because some companies do not pay for the compression needed to open and save GIF files, many tools, especially freeware and shareware ones, cannot manipulate GIF images. However, these tools do support the open-source PNG format, suggesting that more programs will offer PNG-editing capability, while fewer will continue to support GIF.

One drawback to the PNG format is that only Netscape version 4 and higher and Internet Explorer version 4 and higher (commonly referred to as the 4+ browsers) display PNG images. Although most browsers currently used to visit Web sites are

versions 4+, people using older browsers cannot see PNG images. Another drawback is that PNG does not support animation.

PNG also does not compress as well as JPEG. Even though you can store high-color images such as photographs in PNG, you cannot reduce their file size as you can with JPEG.

Table 2-4 shows the differences between the GIF, JPEG, and PNG formats.

**Table 2-4** Comparison of the three Web graphics formats

	GIF	JPEG	PNG
Color	Indexed (8-bit)	RGB (24-bit)	Either indexed or RGB
Compression	Lossless or lossy	Lossy (strong)	Lossless (weak)
Animation	Yes	No	No
Transparency	1-bit	No	Full 8-bit alpha channel
Browser support	Full	Full	Partial

In general, because it supports transparency and animation, GIF is the most versatile image format and the best format to use for most Web graphics. The only reason not to use GIF is when you have a high-color image such as a photograph, in which case JPEG is the better format. As the Web develops, however, PNG might be used more often.

## Emerging Formats

As the Web evolves, new file formats are developed for Web graphics. These emerging formats include SVG, JPEG2000, MNG, and XBMP. Each of these new formats is discussed in the following sections.

### Scalable Vector Graphics

A relatively new image format allows designers to include vector images in their Web pages without requiring that users have a particular plug-in. The **scalable vector graphics (SVG)** format is similar to the common Flash format. While Flash is a proprietary format owned by Macromedia, SVG is a public, open format that can be created by a variety of programs. Like Flash, SVG creates vector graphics with small file sizes, and creates image displays that scale well and print clearly. Unfortunately, current browsers do not support this format without a plug-in. New versions might support this format.

### JPEG2000

The developers of the JPEG format are updating the JPEG format to allow better compression. The new format, which uses the suffix **.jp2**, produces extremely small file sizes without any noticeable loss of image quality. There is no native browser support yet, although you can view JPEG2000 (JP2) images with a plug-in.



## MPEG and MNG

JPEG has an associated animation format called **MPEG** that uses the same algorithms as JPEG, but requires a helper application to be viewed on the Web. Similarly, PNG has a related animation format called **MNG**. The standard is still being developed, so it will be a few years before you can create MNG animations of your own.

## XBMP

Increasing numbers of Web sites offer wireless versions of their pages. These pages have less formatting so that they can fit on the screen of a hand-held device such as a Palm Pilot or Web-enabled cell phone.

Some of these devices display images, but only ones with very low color depths. Specifically, they display a 1-bit format called **X-Bitmap**, or **XBMP**. This format allows only black and white pixels. Most commercial software does not yet support this format, but free software is available that converts a GIF image to an XBMP image.

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## SAVING FILES AS WEB GRAPHICS

In Photoshop, you select a file format for an image when you save the file. To save an image as a Web graphic, first determine which color depth is appropriate for the image. For 8-bit depth or lower, save the image as CompuServe GIF. For 24-bit depth, save the image as JPEG. However, if the image has been converted to Indexed Color mode, the JPEG format does not appear as a format option in the Save As dialog box. Convert the image back to RGB mode to save it as a JPEG.

### Saving Images in the GIF Format

If the image you want to save as GIF is in RGB mode, you can select the color reduction and dithering methods when you save the file. After you do this, or if the image has already been converted to Indexed Color, you can select the row order of the image, either Normal or Interlaced.

Normally, Web graphics take a few seconds to download from the Web server, and only when the complete file has been loaded does it appear in the Web page. When a GIF is saved with interlaced rows, an incomplete version of the image appears before the complete image has loaded. The rest of the image appears when the download is completed. Using interlaced GIFs is useful because it confirms to the user that an image is loading.

To save an image file as a GIF in Photoshop:

1. Open file **2-1.psd** from the Data Disk.
2. Click **File** on the menu bar, and then click **Save As**.
3. In the Save As dialog box, enter **2-1GIF** as the filename, and select the **Chapter 2** folder on your hard drive as the location for the file.

4. Click the **Format** list arrow, and then click **CompuServe GIF (\*.GIF)**.
5. Click the **Save** button.
6. In the Indexed Color dialog box, click the **Palette** list arrow, and then click **Local (Selective)**.
7. In the Colors text box, type **32** (5-bit).
8. Make sure the Forced text box shows Black and White, the Transparency box is checked, the Matte text box shows None, and the Dither text box shows Diffusion.
9. In the Amount text box, type **50**.
10. Click the **Preserve Exact Colors** box to check it.
11. Click **OK**.
12. In the GIF Options dialog box, make sure the Normal option button is selected, and then click **OK**. This saves the image as a GIF with transparency and optimization through color reduction.

## Saving Images in the JPEG format

Recall that you can save RGB mode images as JPEGs, although JPEG images cannot include transparency. If the image contains any transparent areas, you can set a matte color during the save process. Any transparent pixels are converted to the color you specify.

When you save an image as JPEG, you also can select a compression setting for the image. Compression settings run from the quality values 0 to 12. Zero is the maximum compression and creates a very small file at the expense of image quality. A quality value of 12 specifies minimal compression and creates a large file with little or no degradation of the image.

You can preview the effects of compression on an image as you adjust the compression settings. You also can preview the size of the final image file and view the estimated download time for a given modem speed. The default modem speed is 28.8 Kbps (kilobits per second, not kilobytes per second), which is slower than average for most users, but is a good benchmark to use. Use a compression setting that keeps the download time as short as possible without compromising the quality of the image.

You also can set the following format options for an image:

- *Baseline* (“Standard”): The default, this option produces JPEG images that appear in all browsers, but results in slightly larger files.
- *Baseline Optimized*: This option enhances the compression of the image, and creates even smaller file sizes. Very old browsers do not support images saved with this sort of optimization, so avoid using it unless you are confident that your audience is using newer browsers.

- *Progressive:* This option is similar to the interlacing of GIF images. Instead of the image appearing only after it has completely loaded, progressive JPEGs initially appear as a low-resolution version of the image. The resolution improves as the remainder of the image loads. Using the Progressive option sometimes increases file size, but actually reduces it for some images. It is not supported by some older browsers.

To save an image file as a JPEG in Photoshop:

1. Open file **2-1.psd** from the Data Disk.
2. Click **File** on the menu bar, and then click **Save As**.
3. In the Save As dialog box, enter **2-1JPEG** as the filename, and select the **Chapter 2** folder on your hard drive as the location for the file.
4. Click the **Format** list arrow, and then click **JPEG (\*.JPG, \*.JPE)**.
5. Click the **Save** button.
6. In the JPEG Options dialog box, click the **Matte** list arrow, and then click **None**, if necessary. This converts transparent pixels to white.
7. Make sure the Quality text box shows 5. If it does not, drag the **slider** until it does, or click the **Quality** list arrow, and then click **Medium**.
8. Under Format Options, click **Baseline (“Standard”)**, if necessary.
9. Make sure the Preview box is checked and then note the file size and download time at 28.8 Kbps. The file should be about 6.3 K and download in 2.19 seconds on a 28.8 Kbps modem.
10. Click **OK**. This saves the image as a JPEG optimization through compression.

Just as you optimize 8-bit GIF images by reducing the colors in the Indexed Color dialog box, you optimize 24-bit JPEG images by applying a compression setting in the JPEG Options dialog box. Both of these methods are convenient, but Photoshop and ImageReady include additional features for optimizing images.

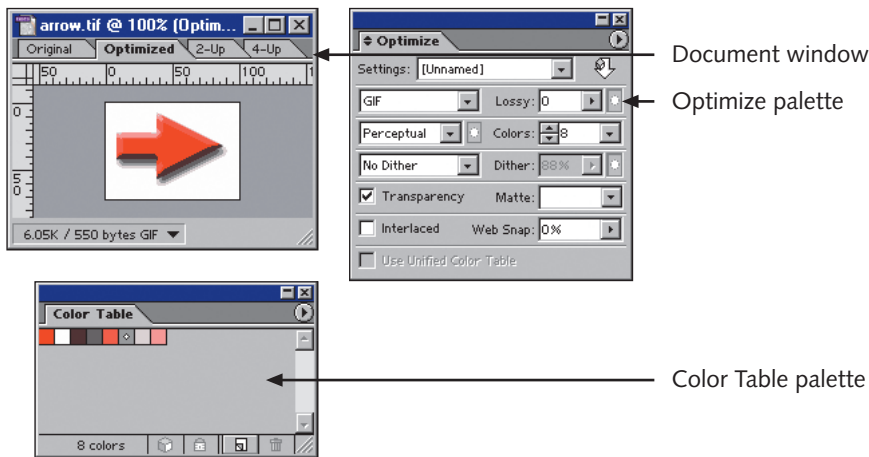
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## OPTIMIZING IMAGES WITH PHOTOSHOP AND IMAGEREADY

The most recent versions of Photoshop include a feature called Save for Web that opens a dialog box, allowing you to optimize an image in any format, while previewing the effects on the image. ImageReady takes this one step further, and has a special Optimize palette that allows you to control optimization settings at any time.

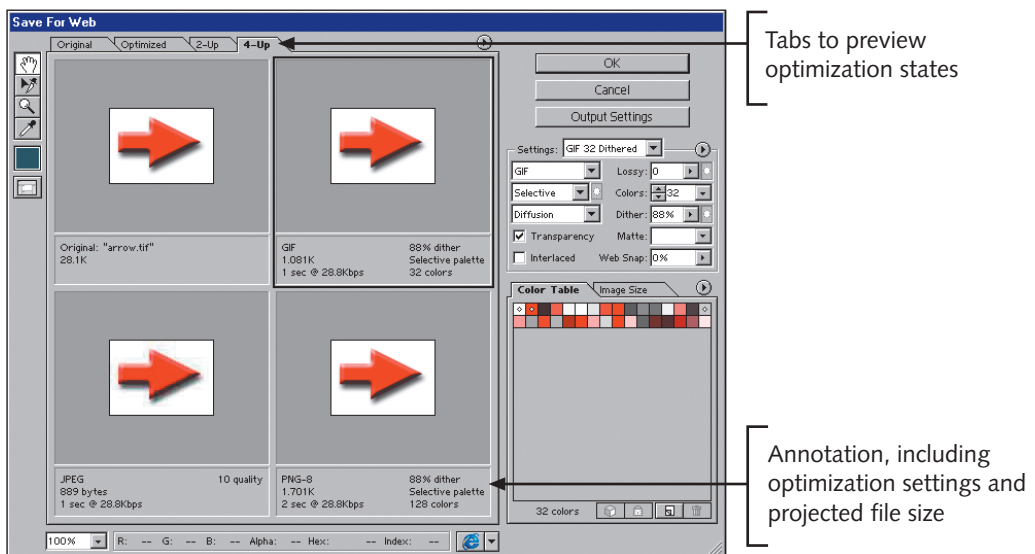
With Photoshop you optimize images after you finish editing. If you reduce color or compress a file and then make further edits, the quality of the image suffers. With ImageReady, however, you can set optimization settings that do not take effect until you save the image. This lets you see the effects of editing and optimization at the same time.

In ImageReady, you use three windows to optimize images: the main Image window (also called the document window), the Optimize palette, and occasionally the Color Table palette. These windows are shown in Figure 2-23.



**Figure 2-23** Three tools for optimizing an image in ImageReady

In Photoshop, these three windows are combined in the Save for Web dialog box, shown in Figure 2-24, along with a few tools from the toolbox.



**Figure 2-24** The Save for Web dialog box in Photoshop

To optimize an image in Photoshop, select Save for Web from the File menu. To optimize an image in ImageReady, use the Optimize palette. Make the palette visible by selecting Show Optimize from the Window menu.

## Previewing Optimized Images

In ImageReady, the Image window always has four tabs along the top. Selecting these tabs allows you to preview different optimization states of the image. In Photoshop, you must select Save for Web to see these tabs. Each tab is described below.

- *Original*: This tab displays the original 24-bit image, without any optimization.
- *Optimized*: This tab displays the image with the currently selected optimization settings. This is a preview of how the image will appear after it is saved.
- *2-Up*: This tab displays two image preview panels next to each other. You can view the original image next to an optimized version, or compare two different optimization settings.
- *4-Up*: This displays four image preview panels in a 2 × 2 table. You can compare different optimization settings this way.

When you select the 2-Up or 4-Up tab, you see annotation about each optimized version at the bottom of every window. The annotation includes the optimization settings for the image and the projected file size of the image when you save it with those settings. As you experiment with different settings, look at the image previews to see how the settings affect the quality of the image. You can hide the annotations to make room for the image previews. You can do this in ImageReady by selecting Hide Optimization Info from the View menu.

If you do not show the annotations, look at the numbers at the bottom of the window to see how the settings affect file size. In ImageReady, at the bottom of the document window are additional choices for how to display information about the image. You can preview the size of the original file, how long it takes the optimized file to download at different connection speeds, or how much file space is saved by using a given optimization setting.

You have only limited editing capability when you preview an image in any panel other than the original, unoptimized view. To make changes to the image, first select the Original panel.

## Using Predefined Optimization Settings

Although you can customize image optimization, you might find it easier to use one of the 12 predefined optimization settings in ImageReady. These contain seven color reduction settings for the GIF format, and use different color depths and dither options. The predefined optimization settings also contain three JPEG settings with different compression options, and two settings for PNG images.

To use a predefined optimization setting in ImageReady:

1. In ImageReady, open file **2-1.psd** from the Data Disk.
2. Save the file as **2-1Optimized.psd** in the **Chapter 2** folder on your hard drive.
3. In the Image window, click the **2-Up** tab.
4. Click the **right panel** to select the optimized version of the image.
5. In the Optimize palette, click the **Settings** list arrow, and then click the first preset optimization setting, **GIF 128 Dithered**. This reduces color to 7-bit using the Selective color reduction method, and activates 88% diffusion dithering for the image.
6. Look at the image previews and compare the quality of the images. Look at the annotation for each panel and compare the file sizes.
7. Select the other presets to find the setting that creates the smallest file without reducing the quality of the image.
8. Save the image with its current name (2-1Optimized.psd) in the Chapter 2 folder of your hard drive.

Once you find a preset that generates good results, you can fine-tune the settings by selecting other options in the Optimize palette. If you change the settings, the option in the Settings text box changes to [Unnamed]. This means that you are customizing the settings.

If you create an optimization setting that you want to save and use later for other images, click the right triangle on the Optimize palette to open the palette menu, and then click Save Settings. In the Save Optimization Settings dialog box, enter a descriptive name for the new setting, and then click the Save button. The new setting now appears in the Settings menu.

## Optimizing GIF Images

When you select GIF as an image format or select one of the GIF presets in the Optimize palette in ImageReady or in the optimization settings area of the Save for Web dialog box in Photoshop, the options change to resemble the Indexed Color dialog box. In ImageReady, make sure to select Show Options from the Optimize palette menu. This expands the palette to display additional options, including transparency.

You then can select options for number of colors, color reduction method, dithering, and so forth. You also can add JPEG-style lossy compression and force the color table to use Web-safe colors. These two options are explained in the following sections.

## Using Lossy Compression

By adding lossy compression, you can sometimes purposely reduce detail and quality of GIF images to reduce file size. Lossy compression is available only for GIF images that are not Interlaced and do not use the Noise or Pattern dither options.

In ImageReady, the Optimize palette includes the Lossy text box. To change the lossy compression, either enter a number from 0 to 100, or click the Lossy list arrow and then use the slider bar to change the value. A value of 0 means no lossy compression is applied. A value of 100 means the maximum amount of compression is applied. At a certain lossy compression setting, you will see artifacts begin to appear in the image. The exact setting depends on the amount of detail in the image. For most images, you should be able to apply up to 5% lossy compression without noticing a difference in image quality. However, this small change saves file size. Increasing the amount of lossy compression increases the amount of image data sacrificed for file size. You can generally apply up to 40% or 50% compression to an image before you significantly degrade the image.

Using lossy compression with GIF images produces artifacts, just as it does with JPEG images. Sometimes these artifacts actually improve the quality of an image by masking any banding between color areas.

## Using Web Snap

Another option for optimizing GIF images is setting a percentage value for Web Snap. This setting controls how to reduce the color table. A Web Snap value of 0% indicates that you want to reduce the color table using the current color reduction method. A value of 100% indicates that you want to reduce the color table using only colors in the Web-safe color table. Recall that Web-safe colors are guaranteed to not dither in any browser in any monitor.

Using an intermediate value for Web Snap helps reduce the number of colors in the table, and helps reduce file size. However, higher values lead to banded color that cannot be remedied, even with full dithering settings.

## Working with the Color Table

As you choose different optimization settings for the GIF format, you can see the colors in the color table change. In ImageReady, make the Color Table palette visible by selecting Show Color Table from the Window menu. From the Color Table palette menu, select Sort by Popularity to sort the colors in the color table from most used to least used. As you decrease the value in the Colors text box in the Optimize palette, the least popular colors are removed from the color table.

Sometimes a particular color is important, even if it is not often used in an image. You can lock specific colors in the color table so that they are not removed by any of the color reduction methods. In the Color Table palette, select a color that you do not want removed, then click the lock icon at the bottom of the palette. Now even when you reduce colors, the locked colors remain.

## Optimizing JPEG Images

Optimizing JPEGs with the Optimize palette is similar to using the JPEG Options dialog box. The key to JPEG compression is the Quality setting in the Optimize palette. Higher quality means lower compression and larger file size. Lower quality means higher compression and smaller file size. Instead of the values ranging from 0 to 12, however, in the Optimize palette they range from 0% to 100%.

The Optimize palette also lets you set the Blur option. Because JPEG compression creates artifacts in an image, you can minimize their appearance by blurring the entire image. In the Blur text box, you can enter any value between 0 and 2, including decimal fractions, to control the pixel radius of the blurring. A high value eliminates most artifacts, but likely makes the image too blurry to use.

## Optimizing by File Size

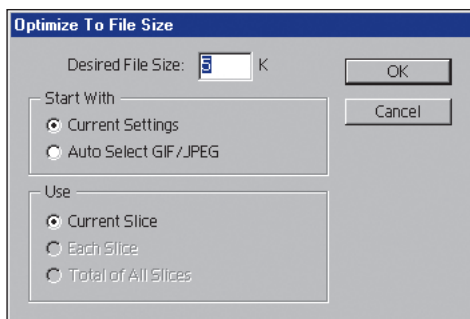
Often Web pages are designed with a fixed total page weight. For example, to make sure a Web page downloads in less than a few seconds, you might decide that all the elements of the page must have a combined file size of less than 60 KB. If the HTML file itself has a size of 30 KB, that leaves another 30 KB for all the graphics on the page. It is then convenient to optimize an image based on a fixed file size, rather than to find the maximum optimization that does not compromise image quality.

To optimize by file size:

1. In ImageReady, click the **right triangle** in the Optimize palette to open the palette menu, and then click **Optimize to File Size**.

In Photoshop, click **File** on the menu bar, click **Save for Web**, click the **right triangle** next to the Settings text box, and then click **Optimize to File Size**.

You will see the Optimize To File Size dialog box, shown in Figure 2-25. Use this dialog box to set parameters, and then let the software find the best optimization settings for you.



**Figure 2-25** The Optimize To File Size dialog box



2. In the Desired File Size text box, enter a target file size for the optimized image.

You will have a good idea of what a reasonable size is after you have optimized several images of different sizes. The target size depends on the dimensions of the image and the number of colors it has. A small image of  $50 \times 50$  pixels with a few colors can be optimized to less than 1 KB. A  $200 \times 200$  pixel photograph, however, might require at least 20 KB. Start with a low number, such as 2, and see how the optimization affects the image. If the image quality deteriorates too much, try a larger target size.

3. To try only optimization settings for the file format currently selected in the Optimize palette, select the **Current Settings** option button. To choose an appropriate format based on the number of colors used in the image, select the **Auto Select GIF/JPEG** option button.

Generally, the Auto Select option produces the best results. However, if the image is an animation, or contains transparency, you must use the GIF format. Set the format to **GIF** in the Settings text box in the Optimize palette, and select **Current Settings** in the Optimize To File Size dialog box to find only optimal GIF optimization settings.

(The other options in the dialog box are for slices, which are covered in a later chapter.)

4. Click **OK** to optimize the image to the file size you specified.

## Saving Optimized Images

After you set the optimization options in Photoshop, click OK in the Save for Web dialog box to save an optimized image. In ImageReady, choose Save Optimized As from the File menu. Both these actions open the Save Optimize As dialog box, where you can choose a location and name for the file. You can overwrite the original image, if you want, but it's a good practice to save optimized images with different names and preserve the original images in case you want to optimize them in the future.



When optimizing, do not choose Save As in ImageReady; this saves the original image without any of the optimization settings.

You can also choose to save an HTML file along with the image. This is useful only if you are saving advanced types of Web graphics, such as image maps or image slices. For most optimized images, you can save the images only. To do so, in the Save Optimized As dialog box, click the Save as type list arrow, and then click Images Only.

## CHAPTER SUMMARY

- The file size of an image is based on the dimensions of the image and the number of colors used in the image.
- Optimizing graphics means reducing the file size of an image as much as possible without sacrificing image quality. Whether you are creating image maps or animated rollovers, you must optimize all Web graphics.
- You can optimize images by reducing the number of colors used in the image.
- Color reduction can result in banding; a remedy for banding is to use dithering.
- Web pages can use three bitmap image formats: GIF, JPEG, and PNG. GIF and PNG images are optimized primarily through color reduction, while JPEG images are optimized through lossy compression.
- The JPEG format is best for photographs and other high-color images. GIF is best for most others.
- GIF is the only format that allows animation without requiring a plug-in.
- Compression can result in artifacts. The remedy for artifacts is to use less compression.

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## REVIEW QUESTIONS

1. How much bigger is one kilobyte than one kilobit?
  - a. Same size
  - b. Eight times bigger
  - c. 24 times bigger
  - d. 1000 times bigger
2. How long does it take to transfer a 5 KB image file over a 40 KB connection?
  - a. Roughly one second
  - b. Roughly four seconds
  - c. Roughly five seconds
  - d. Roughly eight seconds
3. If you have a 100 Kbps connection, what is the biggest image you could transfer in one second?
  - a. 8 KB
  - b. 12 KB
  - c. 120 KB
  - d. 800 KB

4. How many colors are in the palette of an image with a color depth of 7-bit?
  - a. 24
  - b. 64
  - c. 128
  - d. 256
5. How many color channels are there in a 24-bit image?
  - a. 1
  - b. 2
  - c. 3
  - d. 4
6. What is the maximum number of colors in a Color Look-Up Table?
  - a. 8
  - b. 256
  - c. 512
  - d. 65,536
7. What color depth should you use for your images while you edit them?
  - a. 1-bit
  - b. 8-bit
  - c. 24-bit
  - d. 32-bit
8. What is a good color depth for most photographs?
  - a. 5-bit
  - b. 8-bit
  - c. 24-bit
  - d. 32-bit
9. What is not a commonly used color reduction method?
  - a. Adaptive
  - b. Perceptual
  - c. Selective
  - d. Uniform
10. Why would you dither an image?
  - a. To blur the image
  - b. To enable transparency
  - c. To minimize banding
  - d. To reduce file size

11. Which format(s) can be viewed in any browser without a plug-in?
  - a. GIF
  - b. JPEG
  - c. PNG-8
  - d. PNG-24
12. Which of the following formats support transparency?
  - a. GIF
  - b. JPEG
  - c. PNG-8
  - d. PNG-24
13. Which of the following formats support animation?
  - a. GIF
  - b. JPEG
  - c. PNG-8
  - d. PNG-24
14. Which of the following formats support high-color images such as photographs?
  - a. GIF
  - b. JPEG
  - c. PNG-8
  - d. PNG-24
15. Which of the following formats can be optimized through color reduction?
  - a. GIF
  - b. JPEG
  - c. PNG-8
  - d. PNG-24
16. When would you use the Threshold command?
  - a. When reducing color to 8-bit
  - b. When reducing color to 1-bit
  - c. When increasing color to 8-bit
  - d. When increasing color to 2-bit
17. What does a Quality setting of High do to an image?
  - a. Uses maximum lossless compression
  - b. Uses maximum lossy compression
  - c. Uses minimal lossless compression
  - d. Uses minimal lossy compression

18. What is the maximum possible value for the Blur setting when optimizing JPEGs?
  - a. 1
  - b. 2
  - c. 8
  - d. 12
19. What does the Web Snap setting do?
  - a. Allows the image to appear on the Web
  - b. Allows interlacing rows
  - c. Forces colors in the color table to shift to Web-safe colors
  - d. Toggles between transparency and matte
20. Which JPEG options are sure to make the image visible in all browsers?
  - a. Both Progressive and Optimized selected
  - b. Progressive unselected and Optimized selected
  - c. Progressive selected and Optimized unselected
  - d. Progressive unselected and Optimized selected

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## HANDS-ON PROJECTS



### Project 1: Using Interpolation When Resizing an Image

You need to resize an image that already has been optimized, but you see that the resulting image has jagged edges. Increase the color depth to improve the results.

1. In Photoshop, open the image file **2-1.tif** from the Data Disk.
2. Use the Image Size dialog box to increase the height to **100 pixels**, but constraining proportions.
3. The resulting image has jagged edges because there are not enough colors in the color table to resample and interpolate accurately. Undo the image resize.
4. Open the Color Table dialog box. Note the number of colors this image uses—only seven colors, plus one color for transparency. Close this dialog box.
5. Change the mode to **RGB**. This gives the image 16.7 million colors for interpolation.
6. Resize the image again. This time the pixels should be interpolated correctly.
7. The process of interpolation adds colors to the color table. Reduce the color depth back to its original level. Use the Indexed Color dialog box to reduce the number of colors to **8**.
8. Save the image as **2-1.gif** in the Chapter 2 folder on your hard drive.



## Project 2: Copying Image Data Between Images with Different Color Tables

You have two images with indexed color modes. Each has a different clut. Copying image data from one image to the other produces undesirable results. Change the color depth to fix the problem.

1. In Photoshop, open the image files **2-1.tif** and **2-2.tif** from the Data Disk.
2. Select file **2-1.tif**, then select all the image data by clicking the Select menu, and then clicking All.
3. Copy the selected area, then select file **2-2.tif** and paste the selection into the image.
4. The selection adopts the clut of the new image and the colors change. Undo the Paste command.
5. Change the mode of the destination image to 24-bit so that the color table effectively has all colors.
6. Paste again (you do not need to recopy the selection). The selection maintains its original colors. When you are asked if you want to flatten layers, click **Yes**.
7. Use the Indexed Color dialog box to reduce the colors again. When Photoshop prompts you to save layers, click **OK**. For the color reduction method, select **Exact**.
8. Save the image as **2-2.gif** in the Chapter 2 folder on your hard drive.



## Project 3: Creating a 1-bit Image

Your team is preparing a wireless version of your Web site for hand-held devices. They need a smaller, 1-bit version of the logo to appear on these devices.

1. Open the image file **2-3.tif** from the Data Disk.
2. Open the Threshold dialog box.
3. The slider at the bottom of the graph and the number box at the top let you control the dividing value between white and black. Make sure the preview box is selected, and adjust the levels until the image looks as clear as possible, while maintaining the general outline of the logo. When you are finished, click **OK**.
4. Select the **Zoom tool** and zoom in by clicking the image once or twice. You may notice some stray black pixels.
5. Set the background color to white by clicking the **Default Foreground and Background Colors button** near the bottom of the toolbar. This sets the foreground to black and the background to white.
6. Select the **Eraser tool**.
7. In the Options palette, make sure the brush shape is set to block.
8. Erase the stray pixels by clicking them with the eraser. If you need more control, zoom in further with the Magnifying Glass tool.
9. Change the color depth to **3** colors and save the image as **2-3.gif** in the Chapter 2 folder on your hard drive.



## Project 4: Optimizing a Photograph

You need to optimize a photograph. Choose an appropriate format and optimization method.

1. In ImageReady, open the image file **2-4.tif** from the Data Disk.
2. Click the **4-Up tab** to compare multiple optimization settings.
3. Select the image preview in the upper-right panel, and select the **GIF 32 Dithered preset** in the Optimize palette.
4. Select the image preview in the lower-right panel, and select the **JPEG Low preset** in the Optimize palette.
5. Compare the two optimized versions with each other and with the original image in the upper-left panel. Both optimized versions look roughly the same.
6. Use the **Zoom** tool to magnify the image previews. You can see artifacts in the JPEG-optimized image. Increase the Quality to **20**.
7. Both optimized images have minimal banding, but the JPEG-optimized image is less than half the size of the GIF-optimized one. Save the optimized image as **2-4.jpg** in the Chapter 2 folder on your hard drive.



## Project 5: Optimizing a Low-Color Graph

Diagrams and charts often use very few colors because they are generated from vector programs and have no gradient color. Optimize a low-color graph.

1. In ImageReady, open the image file **2-5.tif** from the Data Disk.
2. Select the **4-Up tab** to position the original image on the left of the screen, and a test optimized version on the right.
3. Set the image preview in the upper-right panel to the **GIF 32 Dithered preset**.
4. Set the image preview in the lower-left panel to **JPEG Low**.
5. Compare the two optimized versions. The JPEG version has a larger file size and several artifacts around the black lines in the image.
6. Reduce the colors in the GIF version to **5** colors, and record the file size.
7. Reduce the colors to **4**, and record the file size. Reducing colors in this instance has actually increased the file size by forcing the colors to dither.
8. Disable dithering. This reduces the file size further, but the red color is lost. Increase colors to **5** again.
9. This is a reasonable optimization. Save the optimized image file as **2-5.gif** in the Chapter 2 folder on your hard drive.



## Project 6: Optimizing a Textured Image

Visual texture conceals banding, dithering, and JPEG artifacts. Images with a lot of visual texture usually can be optimized more than images without much visual texture. Optimize this drawing.

1. In ImageReady, open the image file **2-6.tif** from the Data Disk.
2. Use the **4-Up** view.
3. Set the upper-right panel to **GIF 32 Dithered**, and the lower-left panel to **JPEG Low**.
4. The JPEG version shows little degradation. Reduce the Quality to **0**, the maximum compression. The image still shows no obvious artifacts.
5. The file size is about 7.6 KB. Try optimizing through color reduction to reduce the file size.
6. Reduce the colors of the GIF optimization to **4** colors. The file size is smaller, but the black color of the tree trunk is missing.
7. Increase the colors to **16**, and find the dark green or black color in the Color Table palette. Select the color and lock it.
8. Reduce colors to **4** again. The file size is reduced, and the dark color is retained.
9. Save the optimized image as **2-6.gif** in the Chapter 2 folder on your hard drive.



## Project 7: Fine-Tuning an Optimization

Often you can save a few extra kilobytes by tweaking the optimization settings. Optimize another drawing.

1. In ImageReady, open the image file **2-7.tif** from the Data Disk.
2. Use the **4-Up** view.
3. Set one of the panels to a GIF optimization preset, and set another to a JPEG preset.
4. Compare the two optimized previews with each other and with the original image. The image has dark lines, so the JPEG optimization produces noticeable artifacts. The image also has color gradations, so the GIF optimization produces noticeable banding.
5. Zoom in to one of the previews. Notice that all previews are magnified. Find the lowest Quality setting for the JPEG compression that produces no artifacts.
6. Choose **No Dithering** for the GIF preview, and find the fewest colors that do not produce obvious banding. The GIF optimization should have a slightly smaller file size than the JPEG optimization.
7. Try different color reduction methods and different lossy compression settings for the GIF preview to find the one that produces the smallest file size.
8. Save the optimized image as **2-7.gif** in the Chapter 2 folder on your hard drive.





## Project 8: Optimizing to a Specific File Size

The target page weight for a Web page is 80 KB. The HTML file is 50 KB, and you already have 25 KB worth of other graphics on the page. Reduce the image in this project to 5 KB, sacrificing image quality as little as possible.

1. In ImageReady, open the image file **2-8.tif** from the Data Disk.
2. Use the **2-Up** view.
3. Open the Optimize To File Size dialog box, set the Desired File Size to **5 K**, and then select **Auto Select GIF/JPEG**.
4. Click **OK**. ImageReady automatically optimizes the image using JPEG compression so that the file size is under 5 KB.
5. Save the image as **2-8.jpg** in the Chapter 2 folder on your hard drive.

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## CASE PROJECT



All of the images that will appear in your online portfolio need to be optimized. Take all the images of past work you have gathered for your portfolio, and optimize them as GIF or JPEG images, depending on what is appropriate for each image.

Think about how you will lay out the images in different pages of your portfolio. Determine a target size for each page, and make sure that the total file size of all the images on each page does not exceed the target size.